DOCUMENT RESUME

ED 059 586 88 EM 009 546

AUTHOR	Dave, Ashok
TITLE	User Requirements in Man-Machine Interactive Systems.
INSTITUTION	Southwest Regional Educational Lab., Inglewood, Calif.
SPONS AGENCY	Office of Education (DHEW), Washington, D.C.
REPORT NO	SWRL-PP-20
BUREAU NO	BR-6-2865
PUB DATE	22 Feb 72
NOTE	10p.
EDRS PRICE	MF-$0.65 HC-$3.29
DESCRIPTORS	Computers; Display Systems; Environmental Criteria; Feedback; *Human Engineering; Input Output; Input Output Devices; *Man Machine Systems; On Line Systems; Programing Languages

ABSTRACT

The basic objective of the development of man-machine interactive systems is to design a system that will most effectively take into account the limitations and talents of both man and machine, recognizing that the human factors are, in certain aspects, diametrically opposed to those of the computer. This document briefly investigates those elements of a man-machine system which directly affect the interaction between user and system. Hardware elements discussed include data input facilities, data output characteristics, audio input and output, graphic input and output, and user terminal configuration. The importance and intent of interactive generative languages for users are examined in the section on software elements, and the final section describes effective design features for environmental and architectural elements. A matrix comprised of prospective user categories and the elements affecting user-system interaction is included. (Author/SH)

ED 059586

EM
OE-BR
6-2865

SOUTHWEST REGIONAL LABORATORY FOR EDUCATIONAL RESEARCH & DEVELOPMENT

EM 009546

User Requirements in Man-Machine Interactive Systems

22 February 1972 Professional Paper 20

©1972 SOUTHWEST REGIONAL LABORATORY for Educational Research and Development, 11300 La Cienega Blvd., Inglewood, Calif., 90304.
Published by Southwest Regional Laboratory for Educational Research and Development, a public agency supported as a regional educational laboratory by funds from the United States Office of Education, Department of Health, Education, and Welfare. The opinions expressed in this publication do not necessarily reflect the position or policy of the Office of Education, and no official endorsement by the Office of Education should be inferred.

ED 059586

SWRL

SOUTHWEST REGIONAL LABORATORY
PROFESSIONAL PAPER 20
FEBRUARY 1972

U.S. DEPARTMENT OF HEALTH,
EDUCATION & WELFARE
OFFICE OF EDUCATION
THIS DOCUMENT HAS BEEN REPRODUCED EXACTLY AS RECEIVED FROM THE PERSON OR ORGANIZATION ORIGINATING IT. POINTS OF VIEW OR OPINIONS STATED DO NOT NECESSARILY REPRESENT OFFICIAL OFFICE OF EDUCATION POSITION OR POLICY.

TITLE: USER REQUIREMENTS IN MAN-MACHINE INTERACTIVE SYSTEMS

AUTHOR: Ashok Davé

ABSTRACT

User requirements stated in terms of hardware, software, and environmental and architectural design considerations are briefly described. A matrix depicting the elements which affect user-system interaction is presented.

USER REQUIREMENTS IN MAN-MACHINE INTERACTIVE SYSTEMS

Ashok Davé

Much work has been done in the area of man-machine communications system design and the development of optimal configurations. However, this work has been directed primarily to the "design of a machine for a configuration" rather than the "design of the machine and the configuration for the user."

> Everyone talks about the computer user, but virtually no one has studied him in a systematic, scientific manner... Cost, computer technology, communications, legal problems, and marketing are the prime considerations, and, predictably, the user remains the forgotten man. (Sackman, 1970, pp. 45 & 54)

The effective development of man-machine interactive systems requires simultaneous and comprehensive analyses of the hardware/software aspects as well as those relating to its prospective users and applications. The objective is

> to design a system that will most effectively take into account the limitations and talents of both man and machine. It is important to realize that the human factors are in certain aspects diametrically opposed to those of the computer. (Malia & Dickson, 1970, p. 578)

The following design considerations appear relevant:

- characteristics of users (age, sex, education, knowledge, extent of familiarity with the system, etc.)
- characteristics of applications (experimentation and control, analysis, computer-assisted instruction, training, instructional research and product development, etc.)
- state-of-the-art (availability of desirable hardware/software elements)
- economic return
- user acceptability

The following sections investigate those elements of a man-machine system which directly affect the interaction between the user and the system.

HARDWARE ELEMENTS

Alpha/numeric data input facilities. This is one of the most important aspects of a man-machine interactive system, since it enables the user to communicate with the system. The scope of the facilities is constrained by available shelf items. However, various manufacturers offer custom keyboard design services. Flexible keyboard configurations, in which the layout of keys (available in different sizes, shapes, and colors) can be easily changed, are on the horizon. Some companies now use overlays to give the keyboard a new look tailored to a particular application. And there are touch-tone and push button terminals which differ from regular terminal keyboards. Davé (1971) discusses various types of keyboard configurations.

Alpha/numeric data output characteristics. This incorporates items such as character size, provision of capital/small alphabetical letters, color or black and white, intensity of display, screen size, hardcopy output facilities, use of shielding to minimize reflection and noise distraction.

Audio input/output. Included here are user verbal response and system audio output facilities. How complex is it for the user to give a verbal response that can be recorded/accepted by the system? Can the user play back, delete, and update his response? Is he constrained to a certain pitch of voice? Can he respond at his own pace? What is the quality of system audio output? Does the user have volume/tone controls?

Graphic input/output. Alpha/numeric data output is subsumed under graphic output. Size, color, and typography of graphics should be designed to give maximum legibility. How easy is it for the user to graphically input information to the system? What are the relative advantages and disadvantages of a light pen, cursor, metallic stylus, and other graphic input devices?

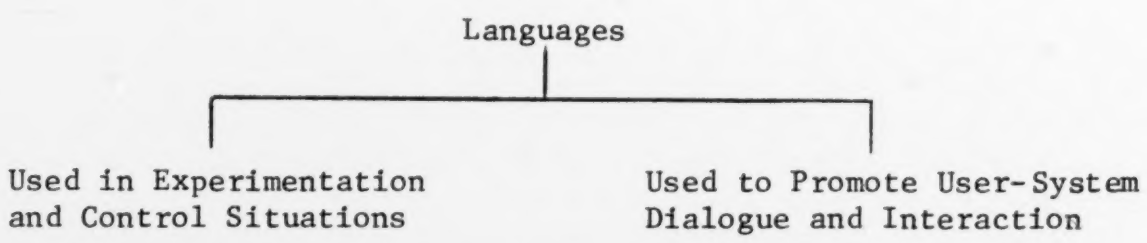
User terminal configuration. Considerations such as the relative placement of keyboards, controls, display, and angle of the keyboard with respect to the user must be investigated. The seating arrangements should be comfortable for correct posture, with ample knee and leg room.

SOFTWARE ELEMENTS

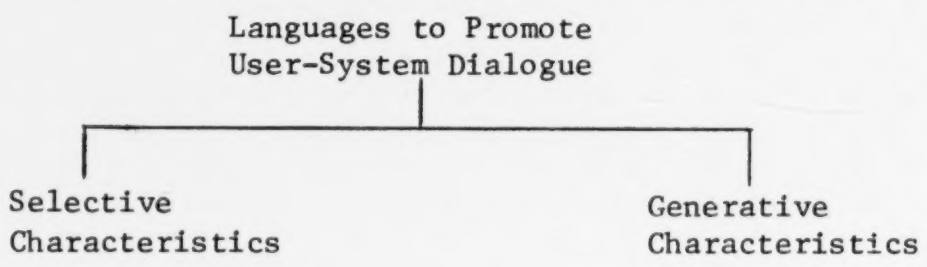
A great amount of interactive facilitation may be incorporated within a carefully designed system software. Unique operating procedures requiring adaptation by the user should be minimized. The system should perform, insofar as possible, on a personal basis, in order to minimize user training. The approach should be to develop an intelligent and personal machine system rather than a hardware system. An efficient software design can also accelerate the system response time, minimizing the user's waiting time at the terminal.

The system should be able to accept user responses transmitted in a natural language and should have some means of acknowledging the receipt of user responses. Sufficient flexibility should be provided in the language to accept a range of user responses. For example, if the user forgets to place a punctuation mark, omits some spacings, or gives the response "I understand" instead of a "Yes" or "Ya" or "OK," the system should be able to remediate without undue repetitive queries to the user. The prime intent of the interactive language should be to promote, encourage and facilitate interaction and dialogue with the system.

Broadly speaking, interactive languages may be classified in two categories:



The inherent features of an experimentation and control language include powerful user response analysis and efficient control of user-system interaction. Languages utilized in man-machine interactive situations should primarily promote the dialogue between the user and the system. The characteristics of this type of language may be further classified:



The man-machine interaction in a system utilizing a language with selective characteristics proceeds on the basis of predefined decision rules and branching criteria. The scope of the interaction is limited, imposing restrictions on the user. Uttal (1968, p. 248) characterizes the activities of selective languages as "a process involving storing, comparison, and finally selection." Selective languages are rigid and provide little interactive flexibility (specially to a user unfamiliar with computers).

On the other hand, generative languages offer extensive flexibility within defined bounds. In this instance, the computer is programmed to manipulate the fundamentals of the subject in which interaction will take place. Thus, the computer's responses to the user are generated on the basis of each individual user's responses and not simply retrieved from a pre-stored data base. Licklider's (1962) preliminary experiments in computer-aided learning and teaching describe the use of generative

languages, whereby a small number of algorithms can perform generally useful functions. Siklossy (1970) describes a computer tutor that knows what it teaches. In this program, a sample is presented to the student who tries to manipulate the sample, i.e., answer the question or solve the problem. Concurrently a performance program manipulates the sample. This performance program knows how to manipulate samples in the universe of the subject matter being taught. Thus, the performance program can solve the problems in some universe; it may answer questions generated by the student; and it can explain how it answers some questions and thereby teach its own methods to the student. Carbonell's (1970) research in computer-assisted instruction uses a generative information-structure-oriented network to answer questions formulated by the student, encouraging a mixed-initiative dialogue between student and computer with questions and answers from both sides. Generative languages require larger computer memory and storage requirements compared to selective types.

ENVIRONMENTAL & ARCHITECTURAL ELEMENTS

Soundproof individual carrels for user-system interaction vary in design and architecture, depending on the type of application. The environment should be designed to conveniently accommodate the hardware components as well as other materials usually needed by the user (such as writing pads, textbooks, user's personal belongings, etc.). There must be some means of controlling and supervising the activities in all carrels (situated centrally or scattered at various locations) from a central control site. When an elementary school child is the user, it may be necessary to provide enough space in the carrel for an adult helper. The interior of the carrels and the hardware components in it need not necessarily be dominated by machines, lights, alarms, and other visual and audible signals. Proper use of different colors and machine covering can make the carrel an attractive micro-environment.

Well-designed carrel lighting systems increase the visibility of visual displays for the user.

> The permissible background illumination--or ambient light level--of a room during the presentation of visual media is determined by the type of media, the mode of projection, and any functions other than viewing which are to take place at the same time. For instance, notetaking during a film presentation will require a higher ambient light level than is normally desirable for viewing alone. (Educational Facilities Laboratories, 1970, p. 39)

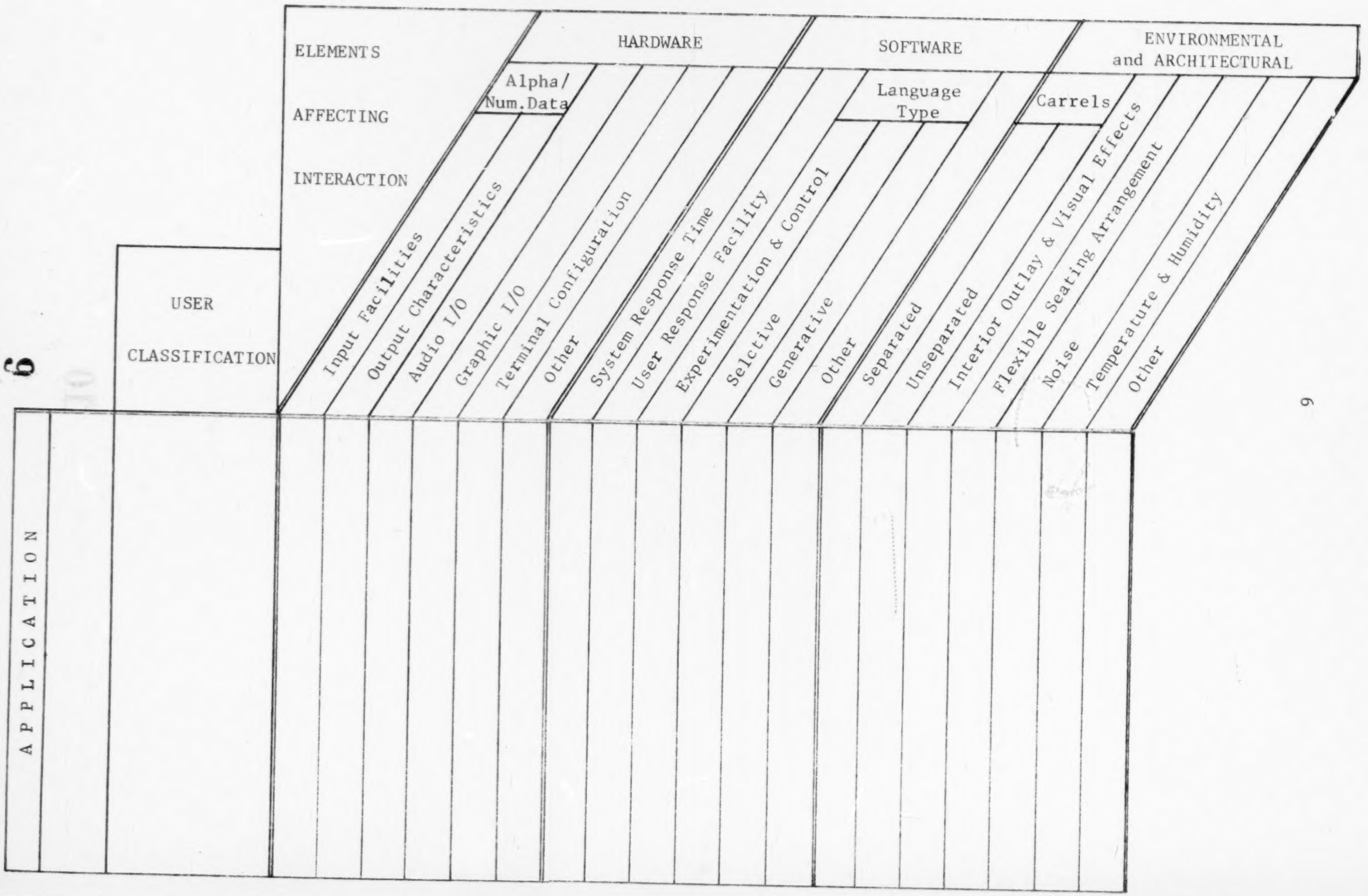
Seating should be comfortable. Flexibility of vertical seating adjustments may be necessary to conveniently accommodate persons of various height. The carrels should be sound attenuated; the hardware components should generate little noise; and the environmental temperature should be "pleasant" for the user.

A matrix comprised of prospective user categories and the elements affecting user-system interaction is shown in Figure 1. The respective user classification is a function of the type of application. For example, if a particular application involves psychological research with children between 10 to 12 years of age, a related broad user classification could then be based upon:

- sex
- age
- socioeconomic-ethnic background
- intelligence quotient (IQ)
- mental/physical handicaps
- grade level
- others

A major question thus arises: Should separate terminals be designed for the various categories of users or can one terminal system be effectively used by several of these categories? Consideration of factors discussed in this paper should play an important role in the design of any kind of man-machine interactive system, if the objective is to facilitate user acceptance.

Fig. 1. Elements Affecting User-System Interaction



References

Carbonell, Jaime R., "AI in CAI: An Artificial Intelligence Approach to Computer-Assisted Instruction," IEEE Transactions on Man-Machine Systems, December 1970, Volume MMS-11, No. 4, pp. 190-202.

Educational Facilities Laboratories, Instructional Hardware/A Guide to Architectural Requirements, 1970.

Licklider, J.C.R., "Preliminary Experiments in Computer-Aided Learning and Teaching," in Programmed Learning and Computer-Based Instruction, Edited by John E. Coulson, New York: John Wiley, 1962, pp. 217-239.

Malia, T.C., and Dickson, G.W., "Management Problems Unique to On-Line Real-Time Systems," Proceedings of the 1970 Fall Joint Computer Conference.

Sackman, Harold, "Experimental Investigation of Computer User Effectiveness," in On the Management of Computer Programming, Edited by George F. Weinwurm, Princeton: Auerbach Publishers, 1970.

Siklossy, L., "Computer Tutors That Know What They Teach," Proceedings of the 1970 Fall Joint Computer Conference, pp. 251-255.

Uttal, William R., Real-Time Computers, New York: Harper & Row, 1968.